

WHAT IS CLAIMED IS:

1. An electron-emitting device comprising:

(A) an extraction electrode and a negative
electrode formed in opposition to each other with a gap
5 between said extraction electrode and said negative
electrode on an electrically insulating substrate;

(B) a first layer formed on said negative
electrode and having an oxide of Ti, an oxide of Zr, or
an oxide of Nb on a surface thereof; and

10 (C) a fibrous carbon grown through a catalyst
particle disposed on a side wall surface of said first
layer on the extraction electrode side.

2. The electron-emitting device according to
15 Claim 1, wherein only the side wall surface of said
first layer on the extraction electrode side is exposed
and the other surfaces thereof are covered with a
material on which a fibrous carbon does not grow as
compared with said first layer.

20 3. The electron-emitting device according to
Claim 2, wherein said material on which a fibrous
carbon does not grow as compared with said first layer,
is at least either one of Ta, Cr, Au, Ag, Pt, and
25 materials of the same kind as a material making said
catalyst particle.

4. The electron-emitting device according to Claim 1, wherein said fibrous carbon consists of a graphite nanofiber, a carbon nanotube, an amorphous carbon, or a mixture thereof.

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5. The electron-emitting device according to Claim 1, wherein said fibrous carbon comprises a graphen.

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6. The electron-emitting device according to Claim 1, wherein said fibrous carbon comprises a plurality of graphens.

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7. The electron-emitting device according to Claim 6, wherein said plurality of graphens are layered in an axis direction of said fibrous carbon.

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8. The electron-emitting device according to Claim 1, wherein said catalyst particle consists of Pd, Ni, Fe, Co, or an alloy thereof.

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9. The electron-emitting device according to Claim 1, wherein an electron emission position from said fibrous carbon is more distant from a surface of said substrate than a position of a surface of said extraction electrode.

10. The electron-emitting device according to Claim 1, wherein said extraction electrode and negative electrode are formed on a surface of substantially planar shape of said substrate and a thickness of said negative electrode is larger than a thickness of the extraction electrode.

11. The electron-emitting device according to Claim 1, wherein said substrate is thicker in a region where said negative electrode is formed than in a region where said extraction electrode is formed.

12. The electron-emitting device according to Claim 1, wherein said conductive layer is formed from on said negative electrode to inside of the gap between said extraction electrode and negative electrode on a surface of said substrate.

13. An electron source wherein a plurality of electron-emitting devices as set forth in either one of Claims 1 to 12 are arrayed.

14. The electron source according to Claim 13, wherein said plurality of electron-emitting devices are electrically connected to a matrix wiring pattern.

15. An image-forming apparatus wherein an image-

forming member for forming an image by collision of emitted electrons is disposed at a position where the image-forming member faces the electron source as set forth in Claim 13.

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16. An electron-emitting device comprising:

(A) a first electrode and a second electrode placed in opposition to each other with a gap between said first and second electrodes on a surface of a substrate; and

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(B) a plurality of fibers electrically connected to said first electrode and comprising carbon as a main component,

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wherein said fibers are placed on a surface of said first electrode facing said second electrode.

17. The electron-emitting device according to Claim 16, wherein each of the fibers comprising the carbon as a main component comprises a graphen.

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18. The electron-emitting device according to Claim 16, wherein each of the fibers comprising the carbon as a main component comprises a plurality of graphens.

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19. The electron-emitting device according to Claim 18, wherein said plurality of graphens are

layered in an axis direction of the fiber comprising carbon as a main component.

20. The electron-emitting device according to
5 Claim 16, wherein electrons are emitted by applying a voltage between said second electrode and said first electrode so that a potential of said second electrode is higher than that of the first electrode.

10 21. The electron-emitting device according to Claim 16, wherein a height from said substrate surface to said fibers is larger than a height from said substrate surface to a surface of the second electrode.

15 22. The electron-emitting device according to Claim 16, wherein a thickness of said first electrode is larger than a thickness of said second electrode.

20 23. The electron-emitting device according to Claim 16, wherein a first layer is placed between said first electrode and said fibers and said first layer comprises a Ti oxide, a Zr oxide, or an Nb oxide on a surface thereof.

25 24. The electron-emitting device according to Claim 23, wherein said fibers comprising carbon as a main component are fibers grown through a catalyst

material placed on said first layer.

25. The electron-emitting device according to
Claim 24, wherein said catalyst material is either of
5 Pd, Ni, Fe, Co, or an alloy thereof.

26. The electron-emitting device according to
Claim 23, wherein said first layer is electrically
conductive.

10 27. The electron-emitting device according to
Claim 23, wherein said first layer is covered by a
second layer over the surfaces other than a surface
facing said second electrode and said second layer
15 consists of a material on which no substantial growth
of fibers comprising carbon as a main component occurs
as compared with said first layer.

20 28. The electron-emitting device according to
Claim 23, wherein said first layer is covered by a
second layer over the surfaces other than a surface
facing said second electrode and said second layer
consists of a material selected from Ta, Cr, Au, Ag,
Pt, and materials of the same kind as a catalyst
25 material.

29. An electron source wherein a plurality of

electron-emitting devices as set forth in either one of
Claims 16 to 28 are arrayed.

30. An image-forming apparatus comprising the
5 electron source as set forth in Claim 29, and a
fluorescent member.